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A Method for Sustainable Carbon Dioxide Utilization Process Synthesis and Design

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As a result of increasing regulations and concern about the impact of greenhouse gases on the environment, carbon dioxide (CO₂) emissions are a primary focus for reducing emissions and improving global sustainability. One method to achieve reduced emissions, is the conversion of CO₂ to useful compounds via chemical reactions. However, conversion is still in its infancy and requires work for implementation at an industrial level. One aspect of this is the development of a methodology for the formulation and optimization of sustainable conversion processes. This methodology follows three stages for the process synthesis, design and more sustainable design. Using a superstructure-based approach a network of utilization alternatives is created linking CO₂ and other raw materials with various products using processing blocks. This will then be optimized and verified for sustainability. Detailed design has also been performed for various case studies. These case studies include multiple pathways for the production of methanol and the production of dimethyl carbonate (DMC). From detailed design and analysis, CO₂ conversion processes show promise as an additional method for the sustainable reduction of CO₂ emissions.

Keywords: carbon dioxide conversion, sustainability, process synthesis